

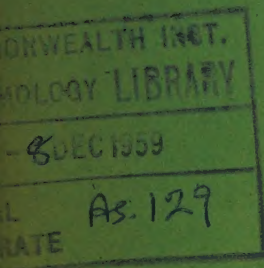


E & A

DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE
MINISTRY OF FOOD & AGRICULTURE, GOVERNMENT OF INDIA

PLANT PROTECTION BULLETIN

SCIENCE IN PRACTICE



सत्यमेव जयते

Issued by the
PLANT PROTECTION ADVISER TO THE GOVERNMENT OF INDIA,
NEW DELHI

1959

SUBSCRIPTION RATES	Published Quarterly	Inland	Foreign
	Single Copy	Rs. 0.75 nP.	1sh.
	Annual	Rs. 3.00	5sh.

Available from

THE MANAGER OF PUBLICATIONS, CIVIL LINES, DELHI—8

DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE
MINISTRY OF FOOD & AGRICULTURE, GOVERNMENT OF INDIA

PLANT PROTECTION BULLETIN

SCIENCE IN PRACTICE



Issued by the

PLANT PROTECTION ADVISER TO THE GOVERNMENT OF INDIA,
NEW DELHI

PRINTED IN INDIA BY THE MANAGER, GOVT. OF INDIA PRESS, FARIDABAD
AND PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI 1959

NOTE

This Bulletin is intended to disseminate information about plant protection measures and campaigns, adopted or conducted in different parts of India, as well as about the advances made in the field of plant protection in other parts of the world to the extent possible. It is also intended to give information about the latest developments in the production and use of pesticides and plant protection equipment as well as about techniques of pest and plant disease control. Elaborate scientific papers on Entomology or Plant Pathology or on the chemistry of pesticides would normally not be in place in this Bulletin but short notes dealing with the behaviour or distribution of pests and plant diseases and brief reports on their epidemiology, control, etc., would be welcome. Plant protection has now become such a specialised science and yet is so diversified and consequential in its character and application that it is difficult to define the scope of the subject with any great precision. The general rule to be observed is that any information which can be useful in preventing or controlling damage to crops, fruit trees, plantations and stored agricultural commodities, caused by pests and diseases, should be a fit subject for publication in this Bulletin.

Manuscripts submitted for publication in the Plant Protection Bulletin must be typed in double spacing on one side of the paper only, leaving ample margin on the left, at the bottom and on the top of the page. Photographs or drawings must be accompanied by a clearly typed legend for being reproduced under them. In addition, they should bear, on the reverse, in clear handwriting in pencil, the name or names of the author or authors and the article which they illustrate. Local names of insects, diseases, weeds, crops and plants, if used, must be commenced with a small, not capital letter and underlined and must invariably be followed by their scientific or well known English names. Localities or place names should be clearly indicated by reference to well known districts or States or both.

While this Directorate will take every care to include only such material in the Bulletin as may be considered reasonably correct and useful, it can accept no responsibility for every statement made and every opinion expressed. Due to various unavoidable reasons, the appearance of this Bulletin has been far behind the scheduled time. While this must be greatly regretted, every effort would be made to avoid delays in future. Those who may read this Bulletin are invited to offer criticisms and suggestions for its improvement.

New Delhi

K. B. LAL,
PLANT PROTECTION ADVISER TO THE
GOVERNMENT OF INDIA

NOTE

This Bulletin is intended to disseminate information about plant protection measures and campaigns adopted or considered in different parts of India, as well as about the advances made in the field of plant protection in other parts of the world to the extent possible. It is also intended to give information about the latest developments in the protection and use of pesticides and plant protection equipment as well as about responses of pest and plant disease control. It is intended to provide a platform for the exchange of views on the various aspects of plant protection. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces.

Information regarding the various aspects of plant protection is to be published in this Bulletin. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces.

The Bulletin will also have to include only such material as is of interest to the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces. It is intended to be a source of information for the various departments of the Government of India and for the various departments of the Government of the States and for the various departments of the Government of the Provinces.

For further information regarding the Bulletin, please contact the Director, Plant Protection, Government of India, New Delhi.

EFFECT OF PESTICIDES ON SOILS AND CROPS

By

K. B. LAL,

*Plant Protection Adviser to the
Government of India,
New Delhi.*

The increasing use of pesticides, specially those that are applied directly to the soil, has caused concern in many parts of the world with regard to their effects on soils, crops and crop produce. The apprehended danger is chiefly from modern, synthetic, chemical pesticides—insecticides of the chlorinated hydro-carbon and organo-phosphorus groups and weedicides, such as, 2, 4-D and MCPA, many of which are commonly used in India. However, some inorganic, chemical pesticides, such as, lead and calcium arsenates and sodium arsenite, have also been known to cause trouble through the soil. There is not much recorded evidence of injury to soils or crops by the use of the preparations of sulphur, copper and mercury, which are the commonest fungicides in use. It should be remembered, however, that every pesticide is a poison and must be treated as such.

Effect on Soil

Pesticides may damage soil fertility by disturbing or destroying its fauna and flora or by poisoning it in other ways. Their effect on the physical properties of the soil may be only through the 'wholesale and permanent' destruction of some soil animals, since the pesticides are not likely ever to be in large enough proportions in the soil to cause physical changes by themselves. For example, the destruction of earthworms may adversely affect the physical structure, underground drainage and water-retaining capacity of the soil. What exactly is meant by soil poisoning is not clear but the result is indicated by the inability of certain crops to grow properly on 'poisoned' soils. Probably the poisoning is the effect of chemical changes brought about by pesticides in the soil or it may be the effect of their mere presence in the soil, which may impair germination and root growth, as well as lead to certain undesirable results in crops and crop produce. The latter, however, is not exactly an effect on the soil but an effect operating through the soil.

The effect of pesticides on the soil must be judged with reference to (i) their rates of application, (ii) the 'concentration in the soil required to produce harmful effects' and (iii) the rate at which the pesticides are 'broken down to harmless products, or otherwise lost from the soil.' These three factors must be considered in relation to one another and ultimately with reference to the susceptibility of various plant species to their effects.

Effect on Soil Fauna

Apart from controlling soil pests for which pesticides may be expressly used, there appears to be little 'evidence of wholesale and permanent destruction of soil fauna such as earthworms, nematodes and micro-arthropoda' (minute insects and allied animals) by the use of BHC and DDT, though the latter has been said to favour phytophagous Collembola. However, it is recognised that the use of pesticides creates changes in the soil fauna, not all of which may be harmless. It is not clearly known what other effects are concurrently produced in the soil when pesticides are used to destroy soil-inhabiting pests. For example, there is a record of potato plants, grown on plots treated with DDT, having been killed by mite attack and this was attributed to changes in plant nutrition and composition induced by the insecticide. An unexpected discovery was made by a worker in the U.S.A. in 1954 that 'annual treatments at normal rates with BHC, DDT, toxaphene or chlordane, could markedly stimulate the growth of the weed, nutgrass,' which is so very common in India.

Effect on Soil Flora

Bacteria constitute the major flora of the soil from the agricultural point of view and their destruction or any serious disturbance in their activities should adversely affect soil fertility. Although the results obtained by various workers are not always in agreement, the general view seems to be that the use of BHC, DDT, aldrin, dieldrin, chlordane, parathion, toxaphene and two, phosphoric, ester insecticides does not create any serious disturbance in the bacterial activity of the soil and the effects are temporary and 'probably less than the normal changes due to cultivation and seasons.'

With regard to the use of the selective weedicide, 2, 4-D, one view has been that 'applied at rates used in practice,' this chemical exerted 'no significant effect on soil bacteria'. On the other hand, three other workers have independently stated that 'the nitrifying organisms were among the most susceptible to the more critical concentrations' of 2, 4-D and according to one of these, 'the inhibiting effect of 2, 4-D on nitrification was increased in the presence of added nitrogen'. However, there has been general agreement that 'any depressing effects on microbial activity in soil are of a transitory nature due to the inactivation of the chemical'. It has been reported that organic herbicides, based on phenoxy compounds, of which 2, 4-D is one, are systemic in their action and may be absorbed by the leaves and carried down to the roots. They may break down in the soil into harmless compounds within a few weeks, but under certain conditions, this may not occur so quickly. In the latter case, 'grains and grass may be planted within a few weeks of 2, 4-D application but sensitive plants, such as beans, peas and tomatoes planted in the spring, have been injured from weed control work the previous fall'.

Pesticidal poisoning of Soils

Poisoning may result from pesticidal residues in the soil, whether the injurious effects on crops are produced as a result of gradual

accumulations over the years or soon after application. DDT 'disappears only very slowly from the soil' and is perhaps the most persistent pesticide known. In contrast, parathion and other phosphorus insecticides are 'rapidly broken down' and are probably the least persistent. In between these two, may be placed BHC which is 'lost from the soil at an appreciable rate' and any residue problem which may arise 'seems likely to be a transitory matter'. Aldrin, dieldrin and chlordane are less persistent than DDT but probably more than BHC. However, there is a record of BHC having remained toxic in out-door soil for two and even five years. A worker has also suggested that even 'the break-down products of BHC are phytotoxic and are absorbed by the soil'. Most of the modern weedicides have been said to 'break down reasonably quickly but a possible residue hazard exists with pentachlorophenol and the sodium salt if used at heavy rates'.

How do pesticidal residues in the soil affect crops apart from their effects on soil fauna and flora? BHC has been well known to cause taints in root crops, notably potato, and is, therefore, not recommended for such crops. It is also said to impair germination and root growth of many crops. Chlordane also has been suspected to cause taints in potatoes. While DDT does not cause any taint, according to one report, 25 lbs. of this insecticide per acre in the soil 'may retard onions, soya-beans, tomato, lima bean, bush bean, spinach and certain ornamentals.' It has been shown that in orchards, where cover crops may be grown, DDT accumulations in the top 3 inches were 14 lbs. per acre in the first year and 46, 50 and 61 lbs. in the succeeding three years. The injury, therefore, is not likely to be so much to the fruit trees as to the cover crops. In the U.S.A., the repeated application of lead arsenate to control orchard pests has been said to make the orchard soil unfit for cover crops. Likewise, cotton soils have been said to be injured by the use of calcium arsenate.

Effect on Crops and Crop Products

Since pesticides must be applied to crops only in concentrations and dosages which would not injure the plant, the question of the harmful effects of pesticides on crops should not arise, unless wrong applications have been made. However, even with correct applications some dangers have been apprehended. First, while a pesticide may control one pest, it may also destroy the natural enemies of another, which were keeping it in check, thereby leading to an outbreak of the second pest. DDT sprays have been known to be followed by severe outbreaks of scale, mite and aphid pests. While DDT has been considered to be the greatest culprit in this respect, some other pesticides, such as, BHC, endrin, chlordane, parathion, sulphur and lime sulphur and zinc and copper sprays have been known to produce similar, undesired and unexpected results. Secondly, the persistent and prolonged use of pesticides may lead to unduly large accumulations of their residues in the soil, about which a little has been said in the previous para.

BHC and DDT are not recommended for spraying or dusting fodder and other crops unless consumable cuttings or harvests are taken at least three weeks after the application. The same should apply to other chlorinated hydrocarbons. Likewise, the use of chemical pesticides must be avoided during fruiting periods, though there can be some exceptions to this rule. Pesticides have been recovered from such products as wines, fruit juices and jam, edible oils, milk, butter, meat and eggs as a result of the original crops, from which the products were manufactured or on which the animals fed, having been treated with pesticides.

General Remarks

Quite a large volume of work on the effects of pesticides on soils, crops, crop products, and human and cattle health has been done by workers interested in agriculture or public health. There is also considerable conflict of opinions, the reason for which may not be obscure in all cases. For example, some of the adverse opinions about BHC and other insecticides have been considered to be due to the fact that the experiments were conducted with bacterial cultures and not in the presence of the soil. In this connection, the value of the soil as a protecting agent against the effects of pesticides on soil-inhabiting organisms has been emphasised. Considerable variations in effects may also be caused by the same pesticide in the same strengths and dosages by variations in the soil itself. For example, BHC is likely to be more phyto-toxic in very sandy than in normal soils. Plants themselves also differ in their susceptibilities to the effects of different pesticides. For example, tomato, cucumber and strawberry are known to be much more sensitive to DDT than some varieties of cabbage and broccoli. In evaluating general effects, much would also depend on what test plants have been used. One reason for the conflicting results may be the fact that the experiments have been conducted at different places and under different conditions, with non-comparable techniques and with hypothetical application strengths and dosages of the pesticides many times more than are normally practised.

(Note: The article is largely based on papers and discussions published in the Proceedings of the Second International Plant Protection Conference held at Fernhurst Research Station, England, in 1956(*Butterworths Scientific Publications*, 1957.)

PERFORMANCE OF BEAVER AEROPLANE IN AERIAL PLANT PROTECTION

By

G. N. BHATIA, B.Sc. (AGRI.) HONS., ASSOC. I.A.R.I.,

*Deputy Locust Entomologist, Directorate of Plant Protection,
Quarantine and Storage, New Delhi.*

Introduction

Considerable progress had already been made in the field of agricultural aviation in some foreign countries, when India used aircraft against the desert locust (*Schistocerca gregaria* Forsk.) for the first time in 1951. From 1951 to 1953, aerial sprayings against locusts were conducted with the help of Piper Cubs and pilots obtained by the Government of India under the Point IV Programme of the U.S.A. Government but during 1954 the operations were carried out against locusts and the sugarcane leaf hopper (*Pyrilla perpusilla* Wlk.) and in 1956 against cotton jassids (*Empoasca devastans* Dist.) by hiring Piper Super cruiser planes and pilots from a flying club in India. The experience thus acquired showed that there was great scope in India for such aerial operations against pests and diseases, and hence the Government of India decided to establish an aerial unit of its own, for intensifying plant protection work and conducting some investigations to improve the standard of aerial spraying and dustings. For this purpose, two Beaver aeroplanes were obtained from the Government of Canada under the Colombo Plan in December, 1956, and one Auster Autocar was purchased from a firm in the United Kingdom in 1957. Simultaneously, the services of a Pilot Specialist were obtained under the Expanded Technical Assistance Programme of the FAO mainly for training Indian pilots in aerial spraying and dusting. Since March, 1957, these Beaver planes have been in use for pest control work as well as for training Indian pilots in aerial spraying and dusting.

Performance of Beaver aeroplane

The plane has an economic cruising speed of 125 miles per hour. For spraying on crops, a speed of 60—100 miles per hour can be maintained with safety and precision, depending upon the area (being free from obstacles) and the length of the field of operations. The flying range with both tanks full of aviation spirit is 375 miles or 3 hours. The landing strip required is about 1,250 feet long and 150 feet wide levelled ground to clear off 50 feet obstacles. The Beaver is airborne in 480 feet and its unusual zooming qualities (1,250 fpm) plus its excellent visibility in the nose-down attitude, with 30 degrees of flap-all, combine to reduce the natural hazards of aerial spraying to the

minimum. The average cruising fuel consumption is about 18 gallons of aviation spirit and $\frac{1}{4}$ gallon of oil per hour. The grades recommended are aviation spirit of 100/130 Octane and mobil oil 120. All-up-weight (A.U.W.) of the plane, recommended by the manufacturers, is 5,100 lbs., including the spraying equipment which weighs 116 lbs. The engine is of 985 Junior Wasp type with 450 H.P. Power loading is 16.2 lbs./H.P. The maximum capacity of the storage tank is 192 Imp. gallons (240 U.S. gallons) but when dust is used it can hold 1,664 lbs.

Description of Spraying Installation

The spraying installation is a boom-and-nozzle system. The large storage tank (fig. 1) is fitted into the fuselage behind the pilot's seat ; it is lined with a neoprene bag and is connected to a transparent tube at the side with a graduated scale to show the quantity of liquid in gallons which is in the tank. An emergency dump valve, with a remote control in the cockpit, is installed in the tank outlet to jettison the entire load. From the storage tank, the liquid flows down with the gravity force to a windmill-driven centrifugal pump (fig. 2) fitted beneath the fuselage near the under carriage. A pressure gauge is installed in the cockpit and connected by flexible tubing to the pump discharge line. The liquid under pressure is then pumped into the booms and emitted through a series of nozzles fitted with a diaphragm type of check valve. The boom has an aerofoil section and extends for the entire wing span of the aircraft. There are 30 nozzles, 15 on each side, fitted along the booms.

The emission rate of the spray liquid can be regulated by varying the sizes of the apertures leading to the booms and to the pipe that bypasses the liquid back to the storage tank by means of two coupled gate valves. The working of these gate valves is diagrammatically shown in fig. 3. The spray control notches, which are 13 in number, and the adjustment stop are installed to the left of the throttle quadrant on the instrument panel in the cockpit.

When the pump is shut off, the pressure in the boom circuit reduces to 7 p.s.i., at which point the diaphragm check valve closes completely.

Performance of Spraying Equipment

In any problem concerning aerial spraying, there are many variables. However, some of these become more or less constant for a given combination of aircraft and equipment, which greatly simplifies calculation and planning.

Aerial sprayings on cotton crop against insect pests were conducted at Fazilka (Punjab), with Beaver aeroplanes fitted with the above mentioned spraying equipment. During these aerial operations the author, with the help of the pilot, conducted some trials and made some field

observations on the performance of the plane and the spraying equipment, which are briefly described below :—

(a) *Emission*.—Five emission tests using different notches of the spraying lever were performed with water as spray liquid. The results observed were as follows :—

Plane						Notch No. of the spraying lever	Discharge gallons/minute
VT-DIV	..	..	..	..	..	4	26.6
Do.	..	..	..	..	..	8	28.5
VT-DIU	..	..	..	..	..	5	37.5
Do.	..	..	..	..	..	5	39.6
Do.	..	..	..	..	..	6	35.3

Thus, if the total load of insecticide liquid taken by the plane is 126 gallons, it would take 3.2 to 4.7 minutes for discharging the entire load. In order to vary the discharge of the spray liquid, the lever has to be adjusted onto different notches, or the number of nozzles on each boom has to be increased or decreased.

(b) *Swath-width*.—Swath width is directly affected by the height of the spraying nozzles above the crop and the velocity of the cross wind component. With a wind velocity of less than 5 m.p.h. and the height of the nozzles 8—10 feet above the crop, the swath width was found to be 80 feet. The manufacturers, however, claim that the swath width would be 120 feet at 25 feet altitude.

(c) *Droplet size and number of drops falling*.—Droplet size of an insecticidal spray is influenced by several factors, *e.g.*, viscosity of the liquid, airspeed of the aircraft, mechanical break-up of the liquid at the point of discharge, etc. At a speed of 90 m.p.h. (approx.) of the plane, the droplet size of Endrex-20 (diluted to make 1% Endrin) was 200 to 300 microns. The number of droplets per sq. inch of 1% Endrin insecticide on the upper-most leaves of the cotton crop was as under :—

Time						Wind speed (approx.)	No. of droplets per sq. inch
06.15 hrs.	..	..	..	..	..	5 m.p.h.	104
06.15 hrs.	..	..	..	..	..	Do.	102
06.15 hrs.	..	..	..	..	..	Do.	113
09.30 hrs.	..	..	..	..	..	5-10 m.p.h.	53
12.30 hrs.	..	..	..	..	..	10-15 m.p.h.	46
13.00 hrs.	..	..	..	..	..	Do.	39

With regard to the distribution of droplets on leaves, a few visual observations were made and the data are given below :—

Time of observation	Wind speed (approx.)	No. of droplets	Position of leaves	% of leaves sprayed
09·30 hrs.	5—10 m.p.h.	53	Uppermost	100
09·30 hrs.	Do.	28	Lower	95
09·30 hrs.	Do.	16	Lowest	95
12·30 hrs.	10—15 m.p.h.	46	Uppermost	—
12·30 hrs.	Do.	12	Lower	—
12·30 hrs.	Do.	4	Lowest	—
13·00 hrs.	Do.	39	Uppermost	—
13·00 hrs.	Do.	10	Lower	—
13·00 hrs.	Do.	1	Lowest	—

(d) *Miscellaneous observations*

- (i) Reversal time (time taken by the plane to reverse for making a second run over the crop for spraying purpose) was found to be 60 seconds.
- (ii) The ferrying speed, as observed on the ground, from the airstrip to the fields to be sprayed was worked out to be 95—100 m.p.h.
- (iii) The operational speed, as observed on the ground, was found to vary from 70—95 m.p.h.
- (iv) Total time of one sortie, after take off, with 126 gallons of spray load, was about 30 minutes when the operational field was adjacent to the airstrip and the area sprayed in one sortie was about 50—60 acres.

Field computations

In order to apply a required lethal dose per acre the lever controlling the discharge has to be adjusted on a particular notch. For this purpose, the required discharge per minute has to be calculated as under :—

Discharge gallons/minute

DOS

465

Dose/gallons/acre

D—Dose in gallons/acre

O—Operating speed in miles per hour

S—Swath width in yards

Example: When the dose to be applied is 2.5 gallons/acre, operating speed 90 m.p.h. and swath width 80 feet, the

$$\text{required discharge will be } \frac{2.5 \times 90 \times 80}{165} = 36.4 \text{ gallons/minute.}$$

From the performance of the plane it is known that a discharge of 36.4 gallons/minute, which is approximate to 37.5 gallons/minute, is given by notch No. 5 (in VT-DIU). So, the lever has to be kept at notch No. 5.

Acknowledgements

The author is grateful to Dr. K. B. Lal, Plant Protection Adviser to the Government of India, for scrutinising the manuscript.

References

PRUTHI, H. S. AND BHATIA D. R. (1953), Trial of aerial methods of control of the Desert Locust (*Schistocerca gregaria* Forsk.) in India, *Indian J. Ent.*, New Delhi, 14(3): 243—56.

YEO, D. AND CONTHS, H. (1957), Some tests with Boom-and-Nozzle installation fitted to the D. H. Beaver Aircraft VP-KNH, *Pesticides Abstracts and News Summary*, 3(2) : 69—71.

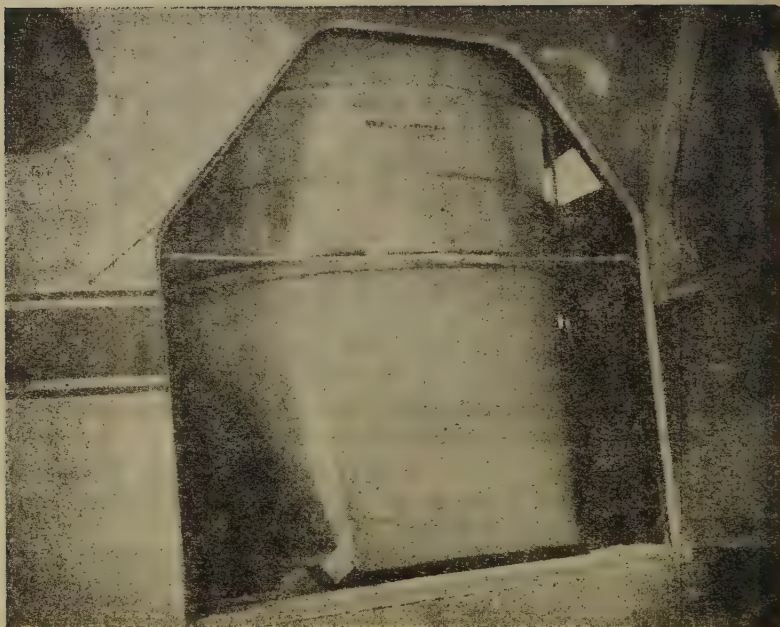


Fig. 1. Insecticide tank fitted into the Beaver aircraft behind the cockpit. Note the graduated glass tube at the side of the tank which shows the quantity of liquid in the tank

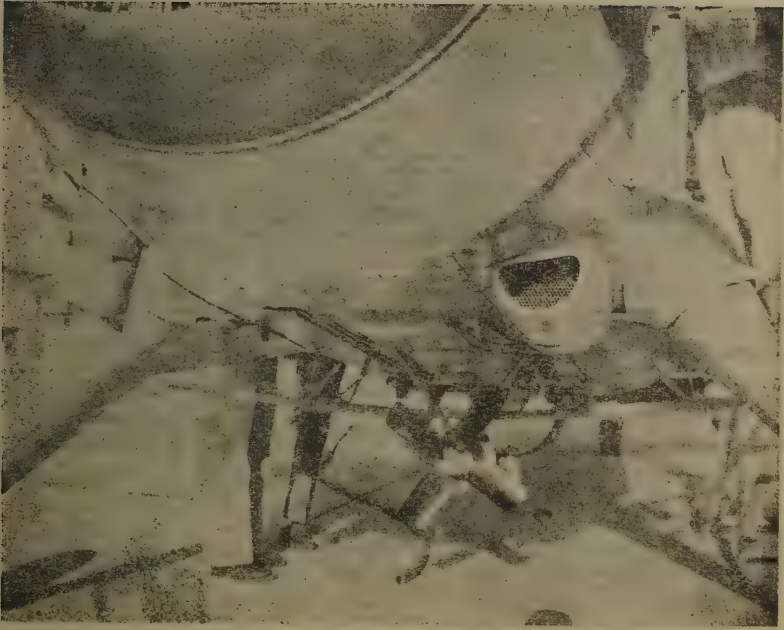
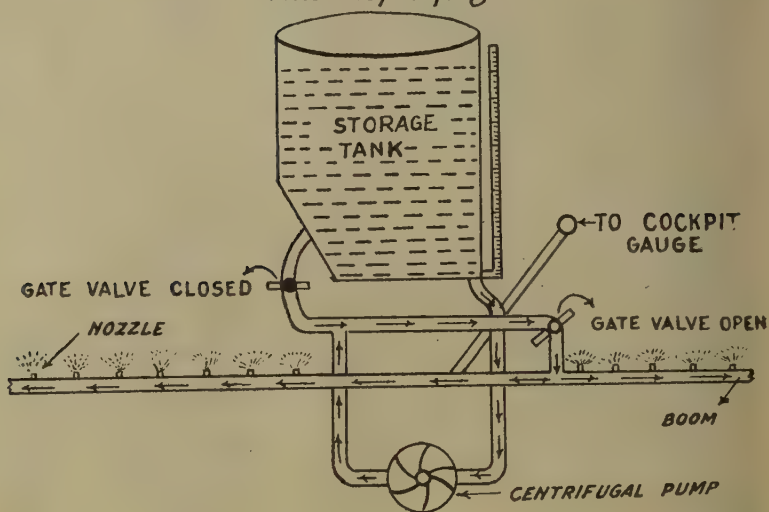


Fig. 2. Full view of the spraying outfit fitted to the Beaver aircraft under the Fuselage

While Spraying



When Spraying is stopped

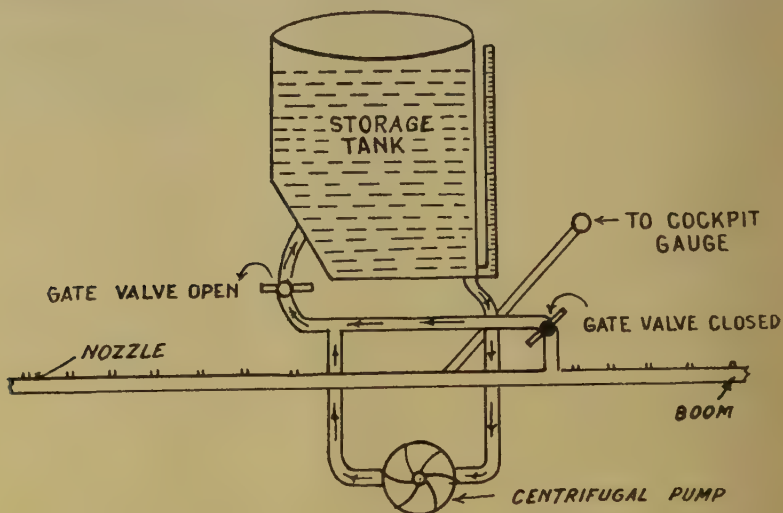


Fig. 3.

OUTBREAKS OF THE SPOTTED GRASSHOPPER IN ASSAM AND WEST BENGAL

By

L. N. NIGAM,

*Directorate of Plant Protection, Quarantine and Storage,
New Delhi.*

The spotted grasshopper, *Aularches miliaris* L., is a pest of coffee, coconut and *Erythrina* in India, and has been recorded also from Ceylon, Tibet, Nepal, Sikkim, Burma, Java and Malaya. It occurs in many parts of India, having been recorded from Kashmir, Uttar Pradesh, West Bengal, Orissa, Madras, Mysore and Bombay States. In Ceylon, it is a major pest in the northern parts of the Central Province, where it damages coconut, arecanut and *Erythrina lithosperma*. In Burma, it is known to attack cotton, sesamum, pigeon pea, castor, coconut, beans, custard apple, *Cordia myxa*, *Cassia*, *Acacia*, *Melia azadirachta*, *Striga* and *Bathioperwa*. In 1911, about 250 acres of cotton crop were reported to have been damaged in Burma by this pest. In 1951, it appeared in large hopper bands and caused damage to some new host plants, e.g., sugarcane, plantain, jute and paddy crops, besides grasses, in Assam and West Bengal.

In Assam, about 30 reports of the appearance of hopper bands in varying numbers were received from about 18 different localities in the district of Darrang (in Tezpur sub-division) during the period, May to August 1951. The hoppers were reported feeding on a variety of plants e.g., plantain, sugarcane, arecanut, coconut, jute, paddy seedlings (*ahu* and *sali* varieties) and wild grasses. The reporting authorities had apparently taken these hopper bands to be those of the desert locust, *Schistocerca gregaria* Forsk. The mistake was discovered when specimens of hoppers, which had been called for, were received. The adults of this pest are not known to form flying swarms. However, reports of flying swarms received from various localities (Kyansi village near Shillong, Golaghat and certain areas in the Naga Hills) in Assam, West Bengal (Diamond Harbour) and East Pakistan (Dacca and Sylhet) during March and April 1951, seem to have wrongly been associated with the spotted grasshopper by the reporting authorities. These were evidently desert locust swarms, as the hopper bands of the spotted grasshopper were noticed only later, i.e., during the latter half of May, and the existence of their adults during March and April was, therefore, out of question.

The hopper bands of the grasshopper were reported from the following localities in Assam:

Date	Locality	Food Plant	Approximate size of bands/Stage of hoppers	No. of bands observed
22-5-51	Kumargaon	Grasslands, young coconut	II stage	—
13—27-5-51	Do.	Grass, sugarcane	2,000 to 50,000 hoppers.	4
29, 30-5-51	Agnigarh Hills	—	II stage, 50,000 hoppers.	2
9—12-6-51	Majgaon (Saikia Saburi)	Sugarcane Do.	12,000 hoppers A few lakh hoppers	3 —
12-6-51	Cole's Park (Tezpur)	—	One lakh hoppers	—
27-6-51	Do.	—	2,000 hoppers	—
29-6-51	Do.	—	5,000—7,000 hoppers	—
13-6-51	Bara Halia	Ahu paddy	2 lakh hoppers	—
13-6-51	Do.	Young arecanut, coconut	8,000—10,000 hoppers	7
15-6-51	Kali bari	—	10,000 hoppers	—
15, 16-6-51	Kumar Saburi	Young arecanut, plantain, wild grasses	One lakh hoppers	—
18-6-51	Kumar Saburi	—	—	—
26-6-51	—	—	10,000 hoppers	—
26-6-51	Garpara Saburi	Sugarcane	One lakh hoppers	—
27-6-51	Dakergaon Do.	Forest Plants Plantain, jute sugar-cane	10,000—12,000 hoppers 10,000 hoppers 19,000 hoppers	— — —
Early July	Bargaon Chapari	Plantain Sugarcane, jute, paddy (<i>sali</i>)	— 2-3 lakh hoppers	—
August	Dihinigia, Noorbara	Plantain, sugarcane and grasses	—	—

It will be seen that the largest band comprising of 2-3 lakh hoppers was seen at Bargaon Chapari, where they damaged plantain and sugarcane leaves severely and attacked jute and *sali* paddy seedlings mildly, over an area of 20 acres. About 2 per cent of this band was comprised of adults, which had emerged about the beginning of July. During August, hopper infestations were reported from the villages of Bargaon Chapari, Dihinigia and Noorbari, where plantain, sugarcane and wild grasses were attacked. On 16th August, a band was noticed in Kumar Chaubari, in which a number of hoppers had developed into sexually mature adults.

In West Bengal, hoppers in large bands were reported in the Diamond Harbour sub-division of the 24-Parganas district in the beginning of May. These hoppers were believed to have hatched out in the last week of April. Considering that the nymphal period of the spotted grasshopper lasts at least 3 months, the adults could not be expected to appear earlier than July. Thus, some flying swarms reported in 24-Parganas in West Bengal, from June onwards, could not have been *Aularches*.

The presence of the hopper bands was noted almost simultaneously during May in Assam and West Bengal. The infestation was confined to Tezpur sub-division in the district of Darrang in Assam and the sub-division of Diamond Harbour in the district of 24-Parganas in West Bengal. Detailed reports of the spread of this pest in West Bengal in the different localities of the district were, however, not available. So far, adult swarms do not seem to have been recorded anywhere, although the occurrence of hopper bands and of large congregations of adults during the oviposition period have been recorded from Ceylon.

In view of the paucity of observations in India, it may not be out of place here to describe briefly the life history of this pest as recorded in Ceylon and the control measures adopted against it there. The life history was studied by Hutson (1926) in Ceylon. According to him, the adults appear late in July and become sexually mature in 3-4 weeks *i.e.*, by the end of August. The adults assemble in large congregations and mate on a large scale about the middle of November, and eggs are laid in pods in the soil during the latter half of November and in the year of mass outbreaks, oviposition may occur anywhere in soils varying from loose sand to stiff clays.

The egg pod is cylindrical in shape and has an outer porous, but firm cover. It may contain 45—155 eggs, which are pale yellow when freshly laid and gradually darken to reddish brown when about to hatch. They hatch out after a diapause of 4 months, which coincides with the dry period lasting up to March. The hopper stage is of the duration of about $4\frac{1}{2}$ months and the adult period lasts about 4 months. Thus there is only one generation in a year. The young hopper lives sedentarily on weeds and low-growing shrubs, but the older ones are more active and move about in bands. The adults fly about and can spread over larger areas but are not known to form swarms or groups. The adult is a large, showy insect with a shining, black head and a yellow face. There are numerous, prominent, yellow tubercles on the pronotum. The fore-wings extend behind the hind knees and have numerous yellow spots, which give it the name 'spotted grasshopper'.

Control measures

Advantage may be taken of its habit of assembling in large numbers for oviposition, when it can be destroyed. The hoppers can be controlled by any of the measures employed to destroy the desert locust, namely dusting with BHC 5%, burning with flame throwers, baiting, trenching, etc. Several of these methods were used successfully in Assam during 1951.

Reference

HUTSON, J. C. (1926), The Spotted locust *Aularches miliaris* L. Yrbk. Dept. Agric. Ceylon, 36—44, Peradeniya.

LIST OF MACHINES SUITABLE FOR PLANT PROTECTION WORK*

No. (1)	Machine (2)	Description (3)	Price (1957) (4)	Supplied by (5)	Suitable for (6)
I. DUSTERS					
HAND DUSTERS					
<i>Plunger type</i>					
1.	Pulvet (German)	Size : Length 26"; Diameter $2\frac{1}{8}$ ". Dust chamber capacity : $\frac{1}{2}$ lb.	Rs. 16.50	New India Corporation, War- den House, Sir Pheroze Shah Mehta Road, Bombay.	Kitchen gardens, nursery beds and low crops, in small areas.
2.	Aspee (Indian)	Size : Length 30"; Diameter $2\frac{1}{8}$ ". Dust chamber capacity : 1 lb.	15.00	American Spring & Pressing Works, Marve Road, Ma- lad, Bombay.	Do.
<i>Bellow type</i>					
1.	Brass Hand Bellow (Indian)	Size : Length 20"; Diameter 6". Dust chamber capacity : 2 lbs.	6.50	Not commercially available yet.	Do.
2.	Tin Hand Bellow (Indian)	Size : Length 20"; Diameter 6". Dust chamber capacity : 2 lbs.	2.50	Do.	Do.
<i>Rotary type</i>					
1.	Hatsuta (Japanese)	Duster resting on belly, body made of nickel-plated brass sheet. Hopper capacity : 8 lbs. Discharge per hour : 8-10 lbs.	86.00	Bombay Chemical Private Ltd., 129, Mahatma Gandhi Road, Bombay.	Dusting crops and vegetables on field scale.

2.	Orient (Indian)	..	..	Duster resting on shoulder, body made of galvanised iron sheet. Hopper capacity : 8 lbs. Discharge per hour : 10-12 lbs.	100.00	American Spring and Pressing Works, Marve Road, Matad, Bombay.	Do.
3.	Shanene (Indian)	..	..	Duster resting on belly, body made of galvanised iron sheet. Delivery pipe provided with 'Y' shaped attachment. Hopper capacity : 9 lbs. Discharge per hour : 10-12 lbs.	84.00	Do.	Do.
4.	Addison (Indian)	..	..	Duster resting on belly, body made of galvanised iron sheet. Hopper capacity : 9 lbs. Discharge per hour : 10-12 lbs.	82.50	Addison & Co., Private Ltd., 158, Mount Road, Madras-2.	Do.
5.	Premier (Indian)	..	..	Duster resting on shoulder, body made of galvanised iron sheet. Hopper capacity : 8 lbs. Discharge per hour : 10-12 lbs.	85.00	Sharma Brothers & Sons, Aishbagh Road, Lucknow.	Do.
6.	Aerodust (Indian)	..	..	Duster resting on belly, body made of galvanised iron sheet. Delivery pipe provided with 'Y' shaped attachment. Hopper capacity : 9 lbs. Discharge per hour : 10-15 lbs.	87.50	New India Corporation, Warden House, Sir Pheroz Shah Mehta Road, Bombay.	Do.

*Compiled by the Directorate of Plant Protection, Quarantine & Storage on the basis of tests and trials conducted by the Directorate as well as by various State Plant Protection organisations.

(1)	(2)	(3)	(4)	(5)	(6)
POWER DUSTERS					
1.	Tornado Jet Junior Indian pattern (English)	Duster provided with one flexible delivery hose. Engine : Villiers Marks 10, 4 stroke, aircooled. Horse power : 1-0. Fuel used : Petrol. Fuel consumption : one gallon for $5\frac{1}{2}$ -6 hours. Hopper capacity : 50 lbs. Discharge per minute: 1-3 lbs. Duster mounted on carrying chassis with detachable wheels.	Rs. 1,650-00	United Provinces Commercial Corporation, 6, Ganesh Chandra Avenue, Calcutta-13.	Dusting all kinds of field crops on an extensive scale.
2.	Baby Agricola (German)	Duster provided with one delivery outlet. Engine : Fichtel & Sachs, 2 stroke, aircooled. Horse power : 1-5. Fuel used : Petrol and Castrol. Fuel consumption : one gallon for $5\frac{1}{2}$ to 6 hours. Discharge per minute : 4-5 lbs. Duster mounted on carrying frame.	815-00	New India Corporation, Warden House, Sir Pheroz Shah Mehta Road, Bombay.	Dusting all kinds of crops.
3.	Matador-100 (German)	Duster provided with one delivery outlet. Engine : Fichtel & Sachs, 2 stroke, aircooled. Horse power : 2-25. Fuel used : Petrol and Castrol. Fuel consumption : one gallon for $4\frac{1}{2}$ -5 hours. Hopper capacity : 60 lbs. Discharge per minute: 2-4 lbs. Duster mounted on carrying frame.	979-25	P. K. Javeri, Plant Protection Department, 32, Shuroff Mansion, 2nd Floor, Princess Street, Bombay.	Do.

4. Aspee Power Duster (Indian)

.. Duster provided with one flexible delivery hose.
Engine : Briggs & Stratton, 4 stroke, aircooled.
Horse power : 1·5/2·5.
Fuel used : Petrol.
Fuel consumption : one gallon for 5-6 hours.
Hopper capacity : 50 lbs.
Discharge per minute : 2-5 lbs.
Duster mounted on carrying chassis with detachable wheels.

1,650·00

American Spring & Pressing Works, Marve Road, Malad, Bombay.

Dusting all kinds of field crops on an extensive scale.

II. SPRAYERS

HAND SPRAYERS

ATOMIZERS

Syringe type

1. Maney pattern (English)

.. Small hand atomizer, made of copper.
Tank capacity : 1 pint.
Continuous pumping required while spraying.

25·00

James Warren & Co., Ltd.,
31, Chowringhee, Calcutta.

Household spraying.

Air compressed type

1. Streely pattern (English)

.. Made of brass.
Tank capacity : 4 pints.

105·00

Do.

Spraying kitchen gardens.

2. Fox (German)

.. Made of nickel plated brass.
Tank capacity : 2 pints.

45·00

New India Corporation,
Warden House, Sir Pheroze Shah Mehta Road,
Bombay.

Do.

(1)	(2)	(3)	(4)	(5)	(6)
BUCKET SPRAYERS					
1.	Hatsuta (Japanese)	.. .. Made of nickel plated brass, pump fitted inside pressure chamber. Discharge per hour : 4-5 gal- lons.	Rs. 120-00	Bombay Chemicals Ltd., 129, Mahatma Gandhi Road, Bombay.	Spraying crops in small areas and nursery beds.
2.	Varun (Indian)	.. .. Made of brass. Pump fitted inside pressure chamber. Discharge per hour : 4-5 gallons.	125-00	American Spring & Pressing Works, Marve Road, Malad, Bombay.	Do.
ROCKING SPRAYERS					
1.	Addison (Indian)	.. .. Mounted on wooden board, single action pump worked with handle. Provided with a delivery hose, a lance, a suction hose and a brass pressure chamber. Height of spray : upto 10 feet. Discharge per hour : 12-15 gallons.	120-00	Addison & Co., Ltd., 158, Mount Madras-2.	Spraying small trees and crops in limit- ed areas.
2.	Sapperlot (German)	.. .. Mounted on a wooden board and worked with handle. Single action pump provided with one delivery hose, a lance, suction hose and a brass pressure chamber.	145-00	New India Corporation, Warden House, Sir Pheroz Shah Mehta Road, Bombay.	Do.

215-00

Double action pump provided with a pair of delivery hoses and a set of lances.
 Discharge per hour : 15-20 gallons.
 With single nozzle. Height of spray : 12½-15 feet.

American Spring & Pressing Works, Marve Road, Malad, Bombay.

Spraying small trees and crops in limited areas.

133-00

Mounted on a wooden board and worked with a handle. Single action pump with one delivery hose, a lance and a suction hose and a brass pressure chamber.
 Double action pump also available.

134-00

American Spring & Pressing Works, Marve Road, Malad, Bombay.

Spraying field crops and nursery plants.

Addison & Co., Ltd.,
 158, Mount Road, Madras-2.

Do.

120-00

Provided with side handle for operating the sprayer.

Galvanised iron tank capacity :

3½ gallons.

Brass tank capacity : 3½

gallons.

Discharge per hour : 7-8

gallons.

140-00

Provided with side handle for operating the machine.

Brass tank capacity : 3½

gallons.

Discharge per hour : 7-8

gallons.

Do.

Shanti Lal & Co., 25, Pollock Street, Calcutta-1.

KNAPSACK SPRAYERS

3. Gator (Indian)

1. Sikar

2. Addison (Indian)

3. Dron-Val (English)

4.	Calimax II (German)	..	..	Brass tank with pressure gauge. Maximum pressure : 140 lbs. per sq. inch. Working pressure : 70 lbs. per sq. inch. Tank capacity : 3 gallons. Discharge per hour : 12-15 gallons.	165.00	New India Corporation, Warden House, Sir Pheroze Shah Mehta Road, Bombay.	Spraying crops on field scale.
5.	Holder Harriden (Indian)	..	..	Brass tank with pressure gauge. Maximum pressure: 205 lbs. per sq. inch. Working pressure: 100 lbs. per sq. inch. Tank capacity: 3 gallons. Discharge per hour: 10-12 gallons	180.00	Shaw Wallace & Co., 4, Bankshall Street, Calcutta.	Do.
BATTERY KNAPSACK SPRAYERS							
1.	'Express-1' (German)	..	..	Charged with hand pump or Patria-Z power sprayer com- bined with charge pump, without pressure gauge. 3 Brass tank capacity : 3 gallons.	210.00	New India Corporation, Warden House, Sir Pheroze Shah Mehta Road, Bombay.	Spraying field crops, tea, coffee, etc.
	'Neu-Rapid' Central charge pump (German)	..	..	Brass pump on four-legged stand, provided with crank lever, pressure gauge, suction hose and charging hose.	250.00	Do.	Charging Express battery sprayers.
2.	Marut battery sprayer (Indian)	..	..	Brass tank with pressure gauge. Tank capacity : 4 gallons.	230.00	American Spring & Pressing Works, Marve Malad, Bombay.	Spraying field crops, tea, coffee, etc.
	Charge pump (Indian)	..	..	Brass pump on tripod stand, provided with crank lever, pressure gauge, suction hose and charging hose.	200.00	Do.	Charging Marut bat- tery sprayers.

(1)	(2)	(3)	(4)	(5)	(6)
			Rs.		
3.	Four Oaks (English)	.. .. Brass tank capacity : 4 gallons. Provided with pressure gauge.	220-00	James Warren & Co., Ltd., 31, Chowringhee, Calcutta-1.	Spraying field crops, tea, coffee, etc.
	Central charge pump No. 3 (English).	Brass pump on four-legged stand provided with crank lever, for charging air and liquid separately. Provided with a suction hose and a charging hose.	800-00	Do.	Charging Four Oaks battery knapsack sprayers.
PEDAL PUMPS					
1.	Hyject (English)	.. .. Worked by foot. Provided with a single deli- very hose, a lance and a suc- tion hose. Height of spray : upto 15 feet. Discharge per hour : 30-40 gallons.	250-00	(i) Richardson & Cruddas Ltd., Byculla Iron Works, Bombay-8. (ii) P. S. T., & Co., 3939, Roshanpura, Eger- ton Road, Delhi-1.	Spraying field crops including medium sized fruit trees.
2.	Maruti (Indian)	.. .. Worked by foot. Provided with one or two delivery hoses, a set of brass lances with adjustable nozzles and a suction hose with strainer. Height of spray : upto 25 feet. Discharge per hour : 50-60 gallons with two nozzles. With single lance attachment. With double lance attachment.	209-12 283-00	American Spring & Pressing Works, Marve Road, Malad, Bombay.	Do.

High volume sprayers

1.	John Bean "Spartan" Model 33C (U.S.A.)	<p>Portable wheel-barrow type sprayer, fitted with a tank, without pressure gauge.</p> <p>Engine : Briggs & Stratton, 4 stroke aircooled.</p> <p>Horse power : 1.34</p> <p>Fuel used : Petrol.</p> <p>Fuel consumption : one gallon for 6-6½ hours.</p> <p>Pump : Piston type.</p> <p>Steel tank capacity : 18 gallons.</p> <p>Discharge per minute : ¾ gallon.</p> <p>Height of spray : 25-30 feet.</p>	1,750-00	Pasha Bhai Patel & Co., Ltd., Construction House, Baidard Estate, Bombay.	Spraying orchards and field crops.
2.	John Bean "Spartan" Model 33KC (U.S.A.)	<p>Mounted on carrying frame, without tank.</p> <p>Other particulars as in (1) above.</p>	1,555-00	United Provinces Commercial Corporation, 6, Ganesh Chandra Avenue, Calcutta.	Do.
3.	Aspee (Indian)	<p>Mounted on angle iron chassis with 2 pneumatic tyred wheels fitted with push handles.</p> <p>Pressure gauge provided, working pressure 200 lbs. per sq. inch.</p> <p>Engine : Briggs & Stratton, 2 stroke, aircooled.</p> <p>Horse power : 1.5-2.5.</p> <p>Fuel used : Petrol.</p> <p>Fuel consumption : one gallon for 4-5 hours.</p> <p>Discharge per minute : 1-2 gallons.</p> <p>Height of spray : 20-25 feet.</p>	1,650-00	American Spring & Pressing Works, Marve Road, Malad, Bombay.	Do.

(1)	(2)	(3)	(4)	(5)	(6)
4.	'Craven' Hydraulic 2-ram-pump .. (Indian pattern) (English).	<p>Mounted on angle iron chassis with 2 pneumatic tyred wheels, fitted with push handles.</p> <p>Provided with pressure gauge, a pair of delivery hoses and a suction hose.</p> <p>Working pressure : 250 lbs. per sq. inch.</p> <p>Engine : Villiers Mark 25, 2 stroke, aircooled. Horse power : 1.5.</p> <p>Fuel used : Petrol 1 part with 1/16th part of Castrol.</p> <p>Fuel consumption : one gallon for 3½—4 hours.</p> <p>Discharge per minute : 1 gallon at 300 lbs. per sq. inch.</p> <p>Height of spray : 35—40 feet.</p>	Rs. 2,650-00	United Provinces Commercial Corporation, 6, Ganesh Chandra Avenue, Calcutta.	Spraying fruit trees and crops on large scale.
5.	Patria-Z (German)	<p>Mounted on carrying frame. Provided with pressure gauge, a pair of delivery hoses, a suction hose and over-flow pipe, with or without charge pump.</p> <p>Working pressure : 250 lbs. per sq. inch.</p> <p>Engine : Fichtel and Sachs, 2 stroke, aircooled.</p> <p>Horse power : 2.5.</p> <p>Fuel used : Petrol 1 part with 1/16th part of Castrol.</p> <p>Fuel consumption : One gallon for 3—4 hours.</p> <p>Discharge per minute : 1.2 gallons.</p> <p>Height of spray : 30 feet.</p>	1,645-00	New India Corporation, Warden House, Sir Pheroz Shah Mehta Road, Bombay.	Do.

6.	Patria-O (German)	..	..	Provided with shut-off cocks with 4 spray outlets and can spray with 1—12 lances at a time. Pressure regulator ; adjustable from 0 to 500 lbs. per sq. inch. Engine : Fichtel and Sachs, 2 stroke, aircooled. Horse power : 3—4. Fuel used : Petrol to start, kerosene to run.	2,100·00	New India Corporation, Warden House, Sir Pheroze Shah Mehta Road, Bombay.	Spraying fruit trees and crops on large scale.
7.	Kingston I (English)	..	..	Mounted on steel frame, capable on trolley or by means of slinging with two poles. Provided with pressure gauge, two delivery control cocks, each controlling 3 delivery hoses, and a suction hose. Working pressure : upto 300 lbs. per sq. inch. Engine : J.A.P. model, single cylinder, 4 stroke, aircooled. Horse power : 2·25. Fuel used : Petrol. Pump : Double acting, horizontal. Discharge per minute : 4 gallons.	3,823·50	Jardine Henderson & Co., Private Ltd., 4, Clive Row, Calcutta.	Do.
8.	Kingston II (English)	..	..	Mounted on carrying frame or trolley. Without pressure gauge. Pump : Double acting, horizontal, driven by heavy duty roller chain. Engine : J.A.P., 4 stroke, aircooled. Horse power : 1·20. Fuel used : Petrol. Fuel consumption : one gallon for 4—6 hours. Discharge per minute : 2 gallons.	2,030·00	Do	Do.

(1)	(2)	(3)	(4)	(5)	(6)
9.	Hatsuta's Triplex (Japanese)	Skid type with carrying handles, which can also be mounted on a trolley. Triple cylinder, horizontal pump. Provided with pressure gauge, a pair of delivery hoses and a suction hose. Engine : Shibaura or Clinton, 4 stroke, aircooled. Horse power : 2-2.5. Fuel used : Petrol. Fuel consumption : one gallon for 4-5 hours. Discharge per minute : $1\frac{1}{2}$ gallons at 250 lbs. p.s.i.	Rs. 1,900-00 300-00 (Extra for trolley)	Bombay Chemicals Ltd., 129, Mahatma Gandhi Road, Bombay.	Spraying fruit trees and crops on large scale.
MIST SPRAYERS AND FOG GENERATING MACHINES					
1.	Fonton (German)	Combined spraying, dusting and fogging unit. Rucksack type. Engine : Sud-Ilo-Werk, 2 stroke, aircooled. Horse power : 1-8. Fuel used : 1 part of mobiloil in 25 parts of petrol. Fuel consumption : one gallon for 6-7 hours. Weight : 44 lbs. with dusting attachment. 37 lbs. with fogging and spraying attachment. Discharge per minute : Spray, 1-4.4 pints. Dust, upto 3.3 lbs.	1,450-00	Jardine Henderson & Co., Private Ltd., 4, Clive Row, Calcutta-1.	Low volume spraying in hilly tracts, on paddy and cotton crops, etc.
2.	Solo (German)	Combined spraying, dusting and fogging unit. Rucksack type. Engine : Klein Motoren,	1,800-00	Saurashtra Trading Co., 137-41, Samuel Street, Bombay-9.	Do.

2 stroke, aircooled. Horse power : 2.0.
 Fuel used : 1 part of mobiloil in 25 parts of petrol.
 Fuel consumption : one gallon for 5.6 hours.
 Weight : 43.5 lbs. with dusting attachment.
 37 lbs. with spraying and fogging attachments.
 Discharge per minute : Spray, 1 pint. Dust, $\frac{1}{2}$ -3 lbs.

3. Swingfog Pest Control Unit Model SN 6. (English).

1,265.00

Jardine Henderson & Co., Ltd., 4, Clive Row, Calcutta-1. Disinfestation of stores and godowns.

Combined fogging and spraying machine. Works on pulse jet system after starting with hand generator or battery.
 Fuel used : Petrol.
 Fuel consumption : one gallon for 3-4 hours.
 Discharge per minute : 3-4 ozs.

III. FLAME THROWERS

1.	Four Oaks Bodkin (English)	..	Brass tank capacity : 3 gallons.	290.00	James Warren & Co., Ltd., 31, Chowringhee, Calcutta. Controlling locusts, burning bushes, weeds, etc.
2.	Janata (Indian)	..	Brass tank capacity : 3 gallons.	190.00	Do. American Spring & Pressing Works, Marve Road, Malad, Bombay.

IV. SEED TREATING MACHINES

1.	Bali (Indian)	..	Gravity mixing type Drum capacity : 1 maund.	125.00	Bali & Co., Opposite P.O., Chandni Chowk, Delhi. Mixing chemicals with all types of seed grains.
2.	Aspee (Indian)	..	Drum shaft rotates on bearings. Drum capacity : 35 lbs.	88.00	Do. American Spring & Pressing Works, Marve Road, Malad, Bombay.

(1)	(2)	(3)	(4)	(5)	(6)
V. RAT FUMIGATING PUMPS					
			Rs.		
1.	Cyano gas Pump (Indian)	.. Brass pump with 1 lb. glass jar.	42.50	Shaw Wallace & Co., 4, Bankshall Street, Calcutta.	Fumigating burrows. rat
2.	Cyano gas Pump (Indian)	.. Brass pump with 1 lb. metal jar.	47.50	Do.	Do.
VI. BIRD SCARERS					
1.	Purivox (German)	.. .. Operated with Calcium carbide. Two pounds of Calcium carbide keep the machine running for 5-6 hours.	200.00	Rajen & Sons, 19, Hamam Street, 4th Floor, Bombay-1.	Scaring away birds and other animals from orchards and crop fields.
2.	Protokrop (Indian)	.. .. Operated with Calcium carbide. Two pounds of Calcium carbide keep the machine running for 6-8 hours.	187.50	Goldstein Engineering & Trading Co., Ltd., Latif Building, Revdi Bazar, Ahmedabad-7.	Do.
VII. SOIL FUMIGATING MACHINE					
1.	Shell D-D Injector Gun (U.S.A)	.. Made of iron. Tank capacity : 4 lbs.	110.00	Burmah Shell Oil Storage & Co., Ltd., (India), Burmah Shell House, Connaught Place, New Delhi.	Fumigating soil against pests.

CEREAL SEED TREATMENTS*

Many cereal diseases are carried with the grain but the proper application of recommended seed treatments can prevent the introduction of disease into a crop through the seed.

Two main types of seed treatment are in common use. One is aimed at controlling those diseases carried on the *outside* of the grain, such as bunt of wheat and kernel smut of sorghum, and the seed dusts and formalin treatment fall into this class. The other type is aimed at controlling those diseases carried *inside* the grain, such as loose smut of wheat and barley. Obviously a seed dust on the outside of the grain will not kill a fungus already inside the grain and the main method used for internally seed-borne parasites is hot water treatment. These treatments are considered hereunder :

Seed Dusts

The three main types of fungicidal dusts used for treating grain are those based on copper, mercury and hexachlorbenzene. They are all used at the rate of 2 ozs. per bushel of seed or slightly more for oats.

Copper Dusts.—Copper carbonate or copper oxychloride dust and the mercury compound dusts are poisons. Care must be taken not to inhale the dusts; when treating seed, a wet cloth placed over the nose and mouth or the use of a dust mask similar to those adopted in some industries will prevent any discomfort or danger in this connection.

A satisfactory dust is one which contains copper carbonate or copper oxychloride equivalent to 50 per cent of metallic copper, which contains not more than one-quarter per cent of copper in a form soluble in water and is so finely ground that $97\frac{1}{2}$ per cent of the dust will pass through a sieve of 200 meshes to the inch. Dusts of this type are now on the market.

Organic Mercury Dusts.—These dusts are now widely used in various parts of the world. They are highly complex compounds prepared by the large chemical manufacturing industries. Covered smut of barley, barley leaf stripe, and the smuts of oats do not respond to the copper carbonate treatment, but very good results have been obtained with the mercury dusts. Some of the organic mercury dusts are Agrosan, Ceresan, Semesan and others.

Hexachlorbenzene Dusts.—These dusts have come into prominence in recent years for the control of bunt. A number of locally produced formulations are now on the market. Experience has shown that hexachlorbenzene dusts should contain at least 20 per cent of the active ingredient to give maximum bunt control.

*Extract from the *Agricultural Gazette of New South Wales*, 68 (1), 1957, 38-39.

It should be remembered that dusted grain is poisonous to birds and animals, although hexachlorbenzene is much less dangerous in this respect than the copper and organic mercury dusts.

Formalin Treatment

This has been largely replaced by the seed dusts. Grain to be treated is placed on a tarpaulin or clean floor and while shovelling, sprinkled with formalin ($\frac{3}{4}$ pint formalin to 40 galls. water) until the grain is uniformly moistened. About $\frac{1}{2}$ gallon of solution will moisten one bushel of seed. While wet, the grain should be covered for four to five hours with wet bags or canvas. It should then be thoroughly dried and bagged in clean bags to prevent re-infection and sown as soon as possible after treatment.

Hot Water Treatment

This treatment is usually only carried out to free small lots of mother seed from internally borne parasites. The grain is tied loosely in a bag and is first soaked in cold water for four to six hours. It is next soaked in water at 120°F. for one or two minutes and then transferred to water at 129°F. for 10 minutes. This ensures that all the grain reaches the required temperature. The water must be kept at 129°F. whilst the grain is being treated.

For these treatments to be most effective, they should be applied carefully and treated grain should be stored in clean bags until sown. Moreover, for best results this grain should be sown on land known to have been free of disease for two or three years.

SHORT NOTE

ANOTHER PEST OF WATERNUT

In the Union Territory of Delhi, *Altica cyanea* Webr. was observed damaging waternut (*Trapa bispinosa* Roxb.) crop severely during August 1956. It was recorded feeding on this crop as early as 1934 by Mcann. Since then, there has been no report about its activity as a pest of waternut (*singhara*) crop.

A. cyanea occurs in association with the *singhara* beetle, *Galerucella birmanica* Jac., and causes damage to leaves, flowers etc., as a result of which the crop soon starts rotting and appears black from a distance.

The beetles are steel blue in colour, about $\frac{1}{4}$ th of an inch long and are present gregariously on the leaves. They feed on the upper surface of the leaves and also on flowers and cut irregular holes. The eggs are cylindrical, pinkish in colour and laid singly on the upper surface of the leaves. The grubs on emergence feed on the epidermis of leaves and scrape away the green matter. Such leaves, in due course, present a mottled appearance and in case of badly damaged leaves decay sets in. The full-grown grub is about $\frac{1}{2}$ an inch long, eruciform in shape, dark brown in colour with spine-bearing black patches all over the body. The grubs have not been observed to pupate on the leaves. They are reported to pupate in the soil, in an earthen cocoon, when they attack paddy or grasses. Further observations on the life and seasonal history of the insect as a pest of *singhara* crop should prove valuable, especially as it is reported as a minor pest of paddy and is also found to occur on grasses, which commonly grow near ponds where *singhara* is planted.

It has been noted that dusting the crop with 5% BHC against *singhara* beetle also controls *A. cyanea*.

B. K. VARMA,
DIRECTORATE OF PLANT PROTECTION,
QUARANTINE AND STORAGE, NEW DELHI.

NEWS AND NOTES

(i) GREASY SPOT YIELDS TO ZINEB FUNGICIDE

Zineb (ethylene bisdithiocarbamate) fungicide is now recommended for control of greasy spot and fruit russetting on oranges and grapefruit, on the basis of experiments at the Lake Alfred Experimental Station, University of Florida. The researches have indicated that either or both of these organisms may cause russetting of the skin. Greasy spot also affects leaves and causes them to drop prematurely. Rust mite, too, causes excessive leaf drop.

Originally, it was believed that greasy spot was caused by the rust mite (*Phyllocoptruta oleivora* Ash.) but the causal agent was later identified as a fungus (*Mycosphaerella horrii* Hara). Another fungus organism causing russet of fruit may also be involved.

Copper fungicides have been used since 1953 to control greasy spot. This treatment tends to scar and blacken citrus with a blemish known as "star melanose", as a result of which it could not be put on the fresh-fruit market. During 1955, experiments with several different dithiocarbamate fungicides were begun. Results showed zineb provides a substantial measure of control.

A residue tolerance of seven parts per million has been set for citrus fruit. Residue analyses have demonstrated that this tolerance can be readily met in commercial practice when directions as to proper use are followed.

[Extract from Du Pont's *Agricultural News Letter*, 25(3), 1957, 16]

(ii) AIRCRAFT IN AGRICULTURE

During the three months ending on June 30, 1956, aeroplanes were used to treat 1,16,034 acres of pasture in New South Wales.

This figure, released recently by the Government Statistician, well illustrates the important role aeroplanes are playing in New South Wales agriculture.

Of the 1,16,034 acres of pasture treated, 1,01,364 acres were treated with 7,512 tons superphosphate and 49,437 lbs. clover seed; 720 acres were treated with 36 tons superphosphate only; 13,950 acres were treated with herbicides, insecticides, etc.

During the same three months, aircraft were also used to treat 1,100 acres lucerne, 200 acres Noogoora burr and 64,102 acres of unspecified vegetation with herbicides, insecticides, etc.

[Extract from the *Agricultural Gazette of New South Wales*, 68 (2), 1957, 94.]

(iii) ALTERNATE HOST OF CANE BORER

The Johnson grass, (*Sorghum halepense*) locally known as *baru* has been observed for the first time, to act as an alternate host plant of the cane borer (*Chilo traea auricilia* Ddgn.) at the farm of the Indian Institute of Sugarcane Research, Lucknow. In 1919, the pest was recorded on paddy but so far studies have failed to reveal its presence on other alternate hosts.

The borer was observed on *baru* during July, 1955. Eradication of this grass during the monsoon months, when the borer migrates to the plant crop, was observed to reduce the average incidence of the borer to 20 per cent during 1955-56, as against 64 per cent and 80 per cent in 1953-54 and 1954-55, respectively.

Biological studies revealed that the borer migrated to the plant crop from *baru* during July and August in its third brood. The egg-laying of the fourth brood began by the end of August and the life cycle continued till the end of September. The emerging moths laid the eggs of the fifth brood on the standing sugarcane crop during the first week of October. The larvae that hatched out remained active from October to February. During the winter months, though the duration of the larval stage were prolonged, the borer did not hibernate and continued to feed as vigorously as before, with the result that infestation increased owing to grown-up larvae moving from cane to cane in the field, even though there was no fresh egg-laying during this period.

Spraying with DDT 0.1 per cent and Endrin 0.1 per cent., brought down the borer incidence to 17.4 per cent and 21.3 per cent, respectively, as against 36.8 per cent in control plots.

Chilo traea auricilia is one of the most destructive pests of sugarcane in India. About 20 per cent of the internodes in the attacked canes are destroyed by the pest, resulting in a loss of about 33 per cent in yield and about 12 per cent in sucrose content.

[Extract from *Indian Institute of Sugarcane Research, Lucknow, News letter*, II(2), 1956, 13.]

